PEXCDF

PURPOSE

Compute the exponential power cumulative distribution function with shape parameters a and b.

DESCRIPTION

The exponential power distribution has the proability density function:

$$f(x, \alpha, \beta) = \left(\frac{e\beta}{\alpha^{\beta}}\right) x^{\beta-1} e^{\left(\frac{x}{\alpha}\right)^{\beta}} e^{-e^{\left(\frac{x}{\alpha}\right)^{\beta}}} \qquad x \geq 0, \alpha > 0, \beta > 0 \qquad \textbf{(EQ Aux-252)}$$

The corresponding cumulative distribution function is:

$$F(x, \alpha, \beta) = 1 - e^{1 - e^{\left(\frac{x}{\alpha}\right)^{\beta}}} \qquad x \geq 0, \alpha > 0, \beta > 0 \qquad \textbf{(EQ Aux-253)}$$

This distribution has been recommended for lifetime analysis when a U-shaped hazard function is desired. This corresponds to rapid failure once the product starts to wear out after a period of steady or even improving reliability. See the Smith and Bain paper listed in the Reference section below for details.

SYNTAX

LET <y> = PEXCDF(<x>,<alpha>,<beta>) <SUBSET/EXCEPT/FOR qualification>

where <x> is a non-negative variable, a number, or a parameter;

<y> is a variable or a parameter (depending on what <x> is) where the computed eponential power cdf value is saved;

<alpha> is a positive number or parameter that specifies the first shape parameter;

<beta> is a positive number or parameter that specifies the second shape parameter;

and where the <SUBSET/EXCEPT/FOR qualification> is optional.

EXAMPLES

LET A = PEXCDF(3,1.5,0.8)

LET X2 = PEXCDF(X1,ALPHA,BETA)

NOTE 1

The general form of the general exponential power cumulative distribution function is:

$$F(x, \alpha, \beta) = 1 - e^{1 - e^{\left(\frac{x-\mu}{\alpha}\right)^{\beta}}} \qquad x \geq 0, \alpha > 0, \beta > 0 \qquad \textbf{(EQ Aux-254)}$$

where μ is a positive location parameter. The case $\beta = 1$ is the truncated extreme value distribution.

NOTE 2

Johnson, Kotz, and Balakrishnan define this distribution with the reciprocal of the a parameter (i.e., simply substitute a with (1/a) in the pdf formula above). They also define a power exponential (or Subbotin) distribution. However, this distribution is distinct from the exponential power distribution defined here. The Subbotin distriubtion is also known as the error distribution.

DEFAULT

None

SYNONYMS

None

RELATED COMMANDS

PEXPDF	=	Compute the exponential power probability density function.
PEXPPF	=	Compute the exponential power percent point function.
EWECDF	=	Compute the exponentiated Weibull cumulative distribution function.
EWEPDF	=	Compute the exponentiated Weibull probability density
WEICDF	=	Compute the Weibull cumulative distribution function.
WEIPDF	=	Compute the Weibull probability density function.
WEIPPF	=	Compute the Weibull percent point function.
EV1CDF	=	Compute the extreme value type 1 cumulative distribution function.

EV1PDF	=	Compute the extreme value type 1 probability density function.
EV1PPF	=	Compute the extreme value type 1 percent point function.

REFERENCE

"An Exponential-Power Life-Testing Distribution," Smith and Bain, Communications in Statistics, 1975, pp. 469-481.

"Continuous Univariate Distributions - Vol. 2," 2nd. Ed., Johnson, Kotz, and Balakrishnan, John Wiley and Sons, 1994 (pp. 63-64).

"Statistical Distributions," 2nd. Ed., Evans, Hastings, and Peacock, John Wiley and Sons, 1994 (chapter 12).

APPLICATIONS

Reliability Analysis

IMPLEMENTATION DATE

96/1

PROGRAM

```
LET A = DATA 1 1 1 0.5 0.5 0.5 2 2 2
LET B = DATA 0.5 1 2 0.5 1 2 0.5 1 2
.
MULTIPLOT 3 3; MULTIPLOT CORNER COORDINATES 0 0 100 100
TITLE AUTOMATIC
TIC LABEL SIZE 3
LABEL SIZE 3
LOOP FOR K = 1 1 9
    LET A1 = A(K)
    LET B1 = B(K)
    X1LABEL ALPHA = ^A1
    X2LABEL BETA = ^B1
    PLOT PEXCDF(X,A1,B1) FOR X = 0 0.01 4
END OF LOOP
END OF MULTIPLOT
```